

## 49. Quality Indicator Problem with two Mics at two PLL

UF0 Doctor, May 20, 2012

Draft 1.0

### 1. Introduction

Distance and Direction finding with Duc050 is based on Ultrasound travel time.

There is a Left and a Right hearing system with Mic's and PLL's.

Every 178 msec the pilot tone of 38 kHz changes to 40 kHz during 1 msec

The PLL detects this frequency shift by a negative transition.

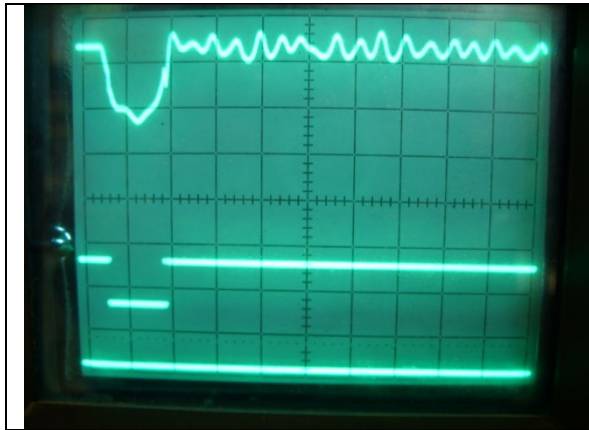


Fig. 1. PLL Signals at perfect acoustic conditions

Top: PLL Analog out, (at 10 Meg Probe)  
1V/Div, 1msec/Div

Mid: PLL Digital out, (at 10 Meg Probe)  
5V/Div, 1msec/Div

Below: Synch Signal (TX, aile)

The travel time  $t_1$  (left) and  $t_2$  (right) is processed by the Arduino. It calculates:

Distance:  $(t_1+t_2)/2 * \text{calibration factor A}$

Direction:  $(t_1-t_2) * \text{calibration factor B}$

The program takes 8 samples and calculates the mean value. If one or many samples are missed, the Quality Factor Q (displayed at the HyperTerminal) increases from 1 to 8.

Meaning of the Quality-Factor Q:

0: No acoustic communication at all

1: Perfect communication, distance and direction reading ok

2-8: Poor communication, distance sometimes usable, direction not usable

### 2. Problem

If both Left/Right system are operating as designed, the Q-Factor gets bad at minor acoustic problems.

IMPORTANT:

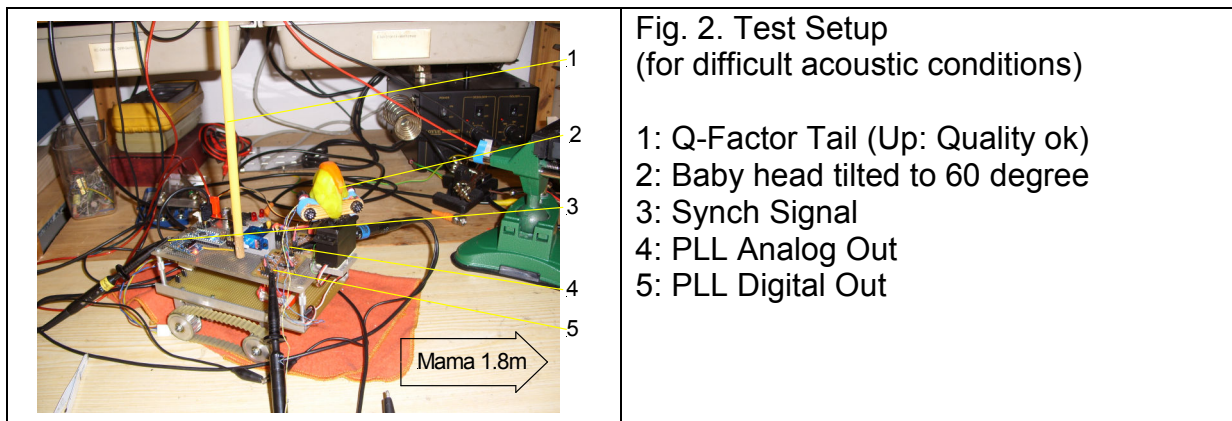
If only one Mic (or both Mics) is switch to both PLL's, the Q-Factor is 1 and we get very good distance data at difficult acoustic conditions, too.

However, we do not receive direction data, of course

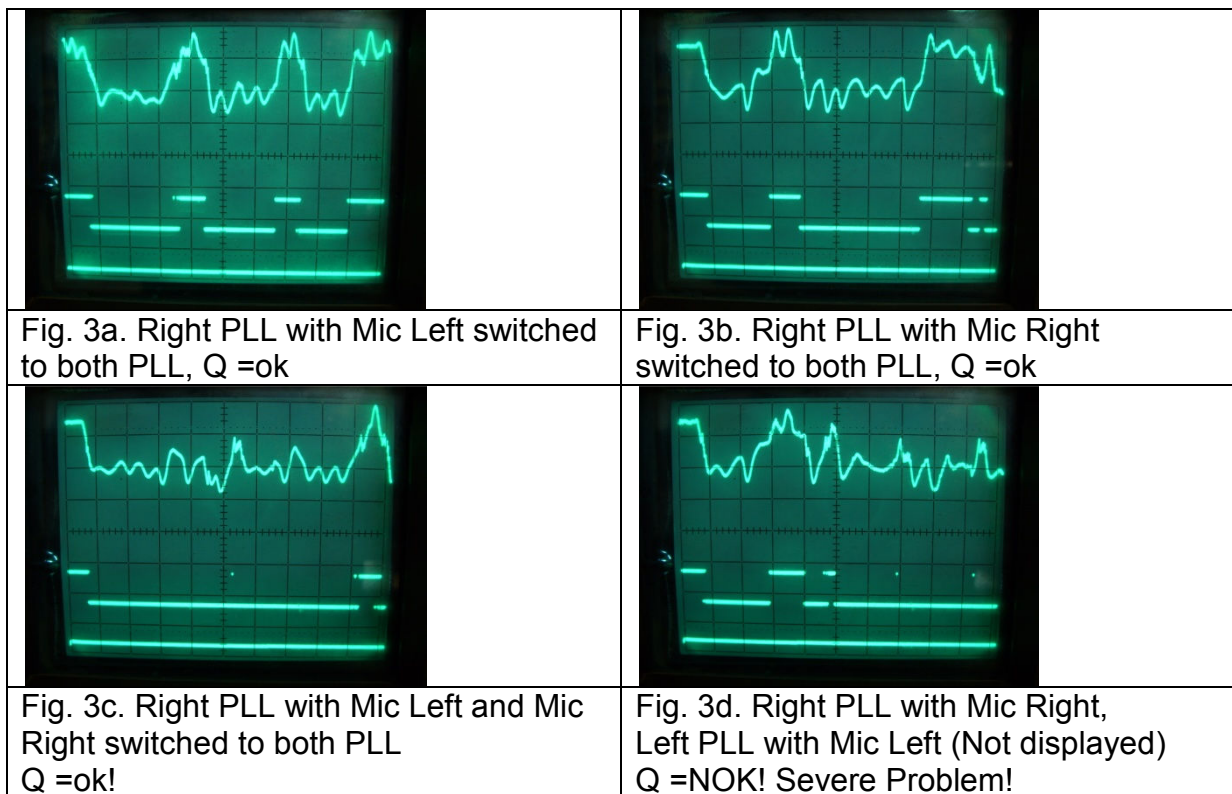
### 3. PLL Signals at difficult acoustic conditions

- The High/Low transitions is ok, but may jitter within 10-100 usec
- The duration of the PLL "Low Pulse" may vary from 1 to 5 msec
- Due to reverberation, we see repetitive "Low Pulse" after the initial Pulse

#### 4. Test Setup for difficult acoustic condition



#### 5. Measuring Results (Settings as given in Fig. 1)



#### 6. Conclusion

At difficult acoustic condition the computation of the direction is not possible. The reason could be the Jitter of the PLL High/Low transition.

However, the main problem is the loss of the good quality factor, needed for giving the still accurate direction data!

At present we do not see a reliable indicator for a bad Q-Factor. The 1msec duration detection of the 40 kHz signal is not recommended for Q-prediction.